9. Renewable Energy

9.1 Introduction

9.1.1 Security of supply is often associated with national self sufficiency and hence (inversely) with import dependency. The increasing dependency of the EU as a whole on fossil fuel imports which may be subject to interruption, for political, criminal, geological, commercial or meteorological reasons which are outside the EU's control, is cited in the Renewables Directive as one of the main drivers of the EU objective of increasing the proportion of its energy needs to be met from renewable sources. Increasing international competition for energy resources, as increased demand from growing economies coincides with increasing scarcity and difficulty of accessing and extracting fossil fuel reserves, has been identified as one of the main threats to the UK's overall security.

9.1.2 The UK has previously chosen to address this mainly through diversification, ensuring that we do not become over-exposed to any one supply source, supply route or import point, and market liberalisation to encourage an efficient and flexible market response to changes in the supply-demand balance. However, there are limits to the extent to which diversification of geographical fossil fuel supply sources is feasible. For example, the world's gas and oil reserves are concentrated in a limited number of countries, as are uranium reserves; and increasingly stringent emissions standards are likely to reduce the number of sources of coal as some types of coal will become unsuitable for use.

9.1.3 Greater use of renewable energy therefore offers another means of diversification and should help to reduce our dependency on imported fossil fuels on an annual basis. For example, the Government's Consultation on the UK Renewable Energy Strategy[115] indicates that increased investment in the UK to meet a 15% renewable energy target in 2020 will reduce *annual* UK gas imports by 12 – 14% in 2020, although the *peak day* import requirement may increase – for example, if a cold day coincides with low wind availability so that electricity demand has to be

115 http://renewableconsultation.berr.gov.uk/

met with increased output from gas-fired generating capacity. The impact on electricity supply of a higher proportion of renewable generating capacity is considered in the box on the impact of increased renewables penetration in chapter 4.

9.1.4 Even without carbon considerations it is clear that in the longer term fossil fuel reserves are ultimately finite and will become increasingly harder and more expensive to obtain. Activity now to develop renewable energy generating technology, and ways of ensuring that it meets our need for secure, reliable energy supply, will smooth the path towards an eventual transition away from fossil fuels.

9.1.5 A Renewable Energy Strategy will be developed in the light of responses to the consultation exercise[116] and published in the first half of 2009. This chapter considers the possible future supply-demand balance of the various renewable resources which the UK is likely to draw on in reaching the target.

9.2 Renewable resources: Supply

9.2.1 The total amount of renewable energy resource available in the UK is high.

Wind

9.2.2 The UK's total wind resource has been assessed as having the potential to deliver over 1,000 TWh of electricity per annum, although the availability of suitable onshore sites and the capability of seabed standing wind turbine generators restrict this to about 150 TWh/annum exploitable resource[117].

Intermittency

9.2.3 However, this power source is not always available. While no energy generating technology capacity delivers all the time, wind power raises particular difficulties in this regard. Wind turbines operate at maximum capacity where wind

116 Responses were not available for analysis as this report was being prepared and so information and conclusions from that source are not reflected here.

117 *Quantification of Constraints on the Growth of UK Renewable Generating Capacity,* Sinclair Knight Merz 2008 (Table 1). Available from http://renewableconsultation.berr.gov.uk/related_documents

speeds are between 14 m/s and 25 m/s , but with wind speeds below 4 m/s the output from wind turbines is zero; and at wind speeds of 25 m/s or above, wind turbines become unstable and stop working.

9.2.4 Individual wind sites are likely to experience wind speeds below 4 m/s about 15% – 20% of the time. However, such effectively-no wind events very rarely affect the whole country (one hour per year where over 90% of the UK experiences wind speeds of less than 4 m/s) and widespread high-wind events are even rarer. For 85% of the time, half or more of the UK experiences some wind. With a good dispersion of wind turbines, aggregated wind output over the UK as a whole can be expected to be smoother than output from any individual site or region[118].

9.2.5 On average, and on both an annual and a daily basis, wind availability varies with electricity demand; it is higher during winter months, and during daylight hours, than it is during the summer and at night.

Variability

9.2.6 Changes in wind speed can have a significant impact on output from wind turbines; for example an increase from 5 to 6 m/s will more than double the output, and an increase from 5 to 10 m/s will multiply it twelvefold. This can present a significant challenge to the requirement to maintain an instantaneous balance between electricity supply and demand. However, such large changes are unlikely to happen very rapidly, with hourly changes of 2.5% the most likely and 99.98% of hourly changes less than 20%[119]; and can usually be forecast some hours ahead.

Biomass/biofuel

9.2.7 Landfill gas is currently the most significant source of biomass-based renewable generation in the UK but the potential for growth is small in the short term as most large landfill sites are already being exploited and may decline in future as sites are depleted. Exploitable resources of sewage gas are expected to plateau after 2020. Further

118 Environmental Change Institute, University of Oxford: Wind power and the UK wind resource, 2005

119 ECI *ibid*

growth in biomass electricity generation is likely to be sourced from waste or energy crops[120].

9.2.8 Total annual capacity for biodiesel production in the UK could reach 1600 million litres per year by 2010 if all planned plant were to become operational and existing plant operates at full capacity, equivalent to just under 6% of the UK's diesel consumption in 2007. However, this level of production would require significant imports of vegetable oils[121].

9.2.9 Total annual capacity for bioethanol production in the UK could reach 600 billion litres per year by 2011 if all planned plant were to become operational, equivalent to around 2.4% of the UK's petrol consumption in 2007. However, this level of production would require significant imports of wheat[122].

9.2.10 A review[123] of biofuel sustainability published in July 2008 concluded that there is probably sufficient land for food, feed and biofuels but recommended that the introduction of biofuels should be significantly slowed down until adequate controls to address displacement effects are implemented and demonstrated to be effective. The Government accordingly stated in the consultation document on the Renewable Energy Strategy that it would not agree to any increase above current biofuels targets unless it is clear that this can be done in a sustainable way.

9.2.11 Biomass is currently the basis of the most important renewable heat technologies in use in the UK. The main types of biomass in use are woody biomass and waste with a high biomass content, such as municipal "black bag" waste.

Wave and tidal power

9.2.12 The potential energy resource from wave and tidal generation in the UK is significant. Because of the direction of the prevailing winds and the size of the Atlantic Ocean, the UK has wave power levels which are among the highest in the world[124] and the tidal range in the Severn Estuary is the second highest in the world. The level of this resource

120 Renewables consultation document para 3.2.11
121 DUKES 2008 para 7.30
122 DUKES 2007 para 7.31
123 http://www.dft.gov.uk/rfa/_db/_documents/Report_of_the_Gallagher_review.pdf
124 DUKES 2008 para 7.42

which could practicably be exploited is limited by the accessibility of suitable sites, but the Carbon Trust has nevertheless estimated that between 15% and 20% of current UK electricity demand could be met from marine and tidal energy[125], including 5% of the UK's electricity demand from the Severn alone[126].

9.2.13 Tidal flows are entirely predictable for many years in advance, but wave strength and speed is correlated with wind speeds and so would be affected by the same issues of intermittency and variability as power from wind turbines.

Hydro

9.2.14 There have been few large hydro schemes constructed in the UK since the 1980s and there are few sites left that would permit the construction of large hydropower schemes. The untapped resource for further hydropower generation in the UK is that from micro and small-scale schemes. Such plants are presently mostly used for domestic or farm purposes or for local sale to electricity supply companies.

Other

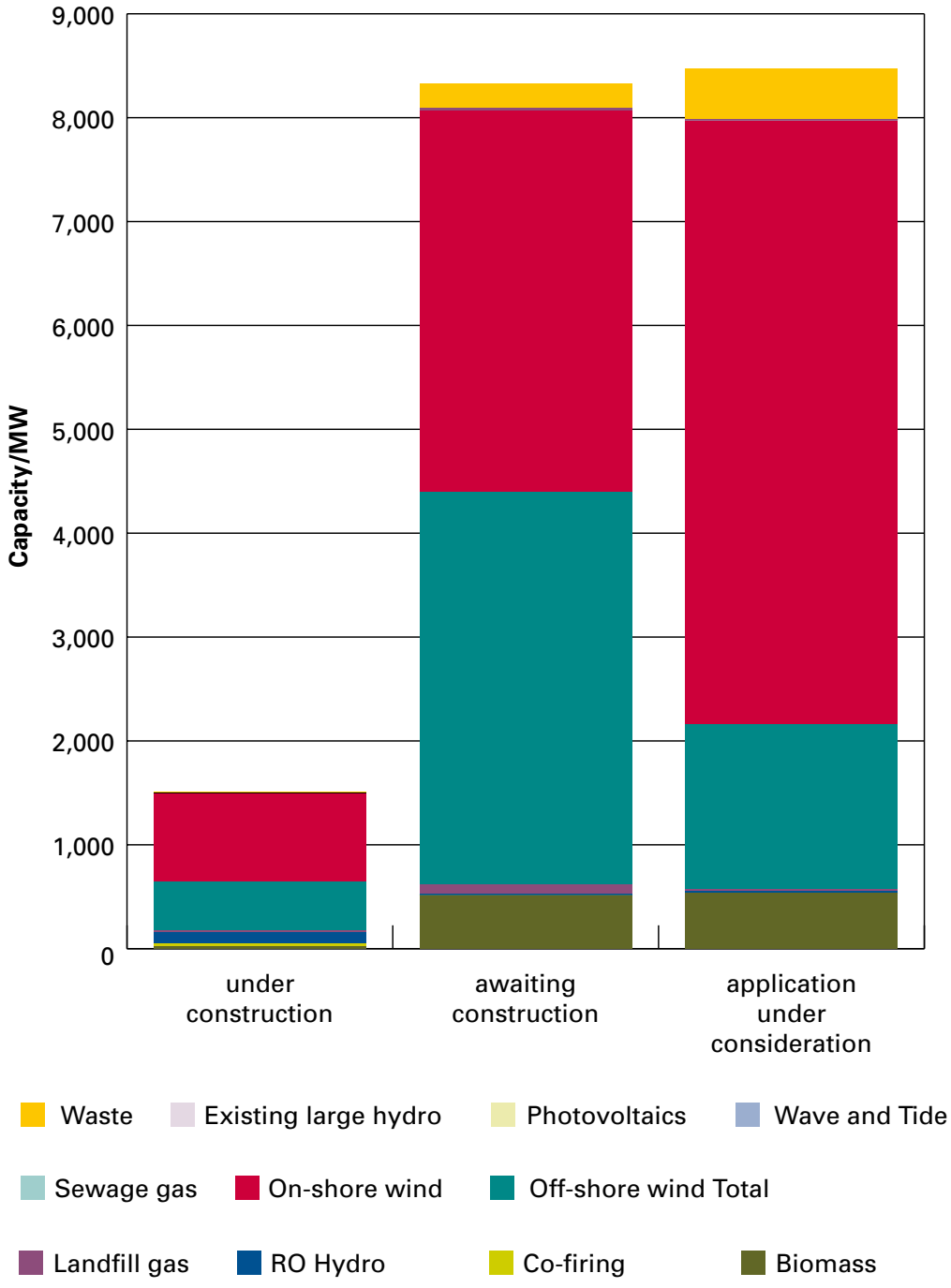
9.2.15 Renewable distributed energy includes a range of technologies including solar thermal, air-source heat pumps, ground-source heat pumps, solar voltaics, micro-wind and micro-hydro to deliver heat and/or electricity to nearby sites or into the local electricity distribution network. It makes a very low contribution to the UK's overall energy supply at present, but the number and variety of sites that could be utilised for generation make clear that community distributed energy has the potential to make a significant contribution to renewable energy and carbon reduction targets[127].

125 "Future Marine Energy", The Carbon Trust 2006 http://www.carbontrust.co.uk/publications/publicationdetail.htm?productid=CTC601
126 "Turning the Tide: Tidal Power in the UK" Sustainable Development Commission 2007 http://www.sd-commission.org.uk/pages/tidal.html
127 Renewables consultation document para 5.1.3

9.3 Renewable resources: Demand

9.3.1 The extent to which these resources will actually be used, will depend on the extent to which renewable generating capacity is deployed.

Chart 9.1: Renewable electricity generating capacity under development



Source: RESTATS[128] progress datasheet of September 2008

128 http://www.restats.org.uk/2010_target.htm

9.3.2 As at September 2008 there was some 1.5 GW of renewable electricity generating capacity under construction, of which slightly more than 60% was contributed by projects larger than 50MW which therefore required the Secretary of State's consent under section 36 of the Electricity Act 1989. A further 8.3 GW had consent from the Secretary of State or from the Local Planning Authority; and applications from a further 8.4 GW were being considered.

9.3.3 As with plans for conventional capacity, it is likely that not all of the capacity presently at early stages of the planning and development process will actually be built. Conversely, in due course it is likely that capacity which is not presently included within these totals will be built.

9.3.4 The construction of new renewable electricity generating capacity faces similar pressures to those confronting conventional generating capacity, as discussed at paragraph 4.5.4 above. These pressures are examined in detail in a report[129] published alongside the Renewable Energy Strategy consultation. Of the supply chain constraints, this identifies in particular:

- the availability of wind turbine generators;
- the availability of specialist vessels for their installation offshore;
- the supply of high voltage AC and DC cables to connect offshore wind farms to the onshore electricity infrastructure;
- other plant equipment such as transformers and switchgear;
- biomass fuel supply;
- skilled engineering resources.

9.3.5 The consultants identified also that many of these gaps represent a commercial opportunity for new manufacturing capacity in the UK.

9.3.6 We examine here two cases from the Redpoint consortium's modelling[130] of the impacts of various possible policy approaches to delivering a higher level of renewable electricity in pursuance of the EU renewables target, which

129 *Quantification of Constraints on the Growth of UK Renewable Generating Capacity* Sinclair Knight Merz 2008. Available at http://renewableconsultation.berr.gov.uk/related_documents

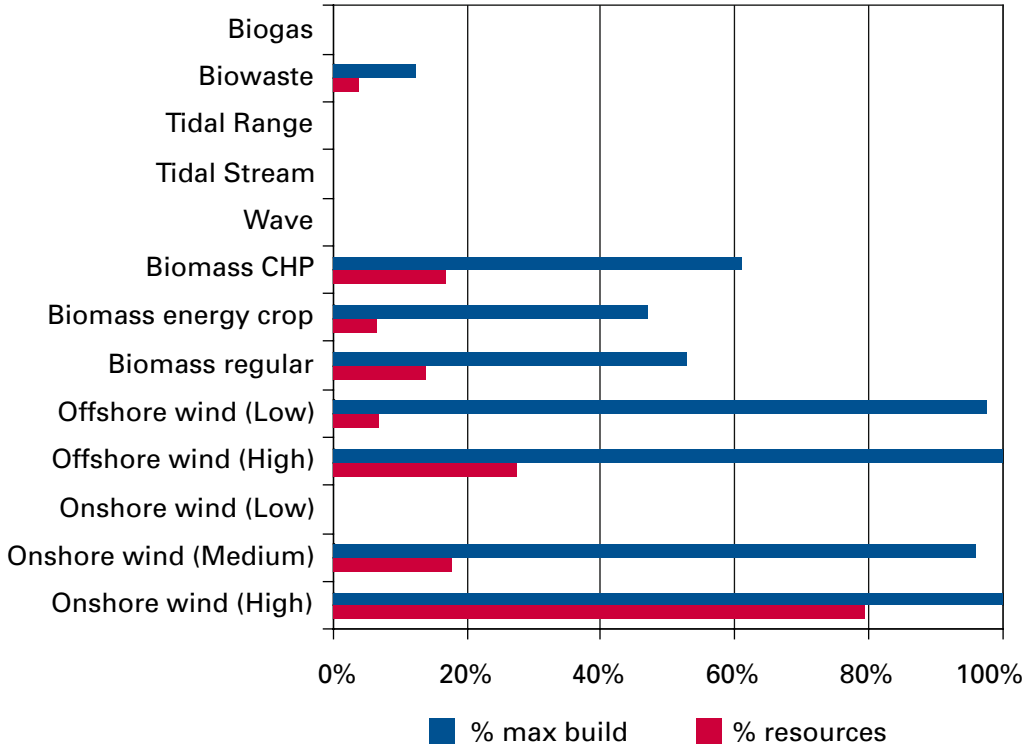
130 *Implementation of EU 2020 Renewable Target in the UK Electricity Sector: Renewable Support Schemes* Redpoint *et* al 2008.
Available at http://renewableconsultation.berr.gov.uk/related_documents

takes into account the constraints on the deployment of new capacity identified above.

9.3.7 Under the status quo case, under which no action is taken beyond that already under way, nearly 12 GW of new renewable electricity generating capacity, the vast majority of it onshore and offshore wind, is expected to be deployed by about 2020. This would be a four-fold increase over present levels but still within the maximum possible build rate for several technologies and also well short of utilising all the available resource.

9.3.8 For example, the chart below shows that under this scenario, offshore wind is built at or close to the maximum rate possible under a business-as-usual case, but only about half as much regular biomass capacity is built as would be possible (blue bars). Also under this scenario, about 80% of the UK's onshore high-wind potential but only about 30% of its offshore high-wind potential is exploited (red bars).

Chart 9.2: Exploitation of the UK's renewable resource potential under the Status Quo scenario

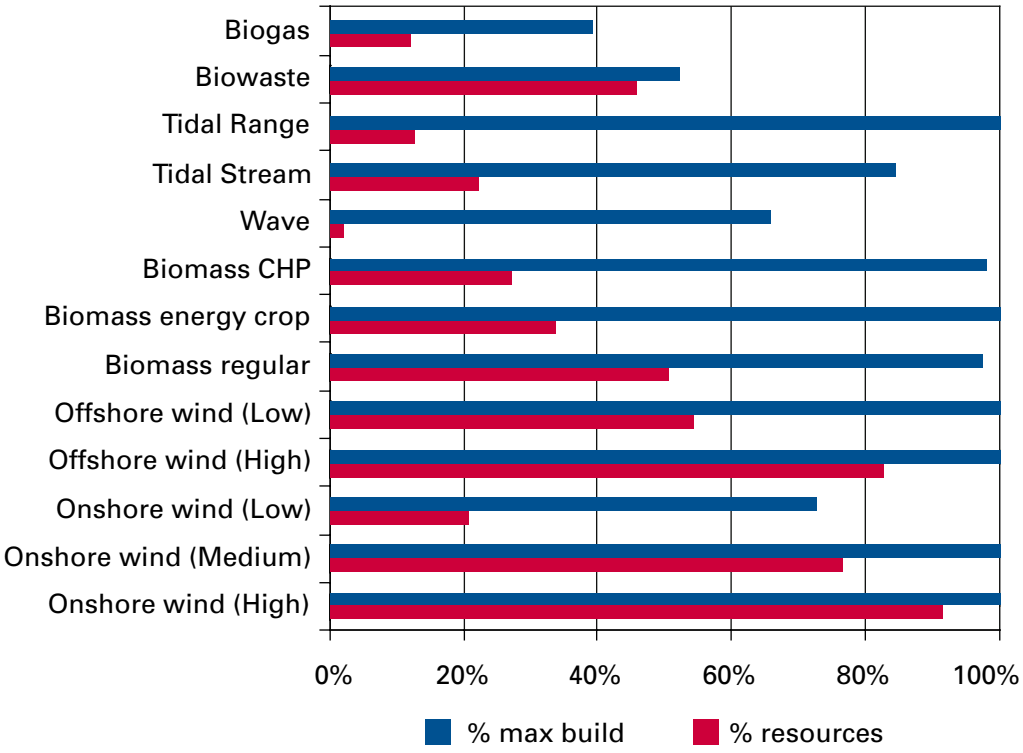


Source: Redpoint

9.3.9 This shows that there will still be plenty of unexploited renewable resource by 2020 except in the area of onshore high-wind potential.

9.3.10 In a case where the Government seeks to deliver the UK's share of the EU renewables target by extending the Renewables Obligation to deliver 32% of electricity from renewable sources by 2020, the market is modelled to respond by delivering as much new capacity as is possible, under an optimistic scenario regarding constraints on new build, in several sectors. However, the red bars again show that there remains plenty of potential resource still to be tapped.

Chart 9.3: Exploitation of the UK's renewable resource under the RO32 scenario



Source: Redpoint

9.4 Conclusions

9.4.1 The UK has excellent renewable resources but converting this energy into usable heat, electricity and transport to deliver the UK's share of the EU's target of delivering 20% of energy demand from renewable sources by 2020 presents a major challenge. The Government's 2008 Renewables Consultation sought views on how to drive up the use of renewable energy in the UK, and will help to shape the UK's Renewable Energy Strategy. This is due to be published in the first half of 2009.